XXI. *Contributions to the Chemistry of the Urine.* PART II.—*On the Variations in the Alkaline and Earthy Phosphates in Disease.*

By HENRY BENCE JONES, *M.A., Fellow of the Royal College of Physicians. Communicated by* THOMAS GRAHAM, *Esq., F.R.S., &c.*

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On the Variations in the Earthy and Alkaline Phosphates in Disease.

THE object of the following experiments was to show to what extent the amount of phosphatic salts was increased in disease. Unexpectedly, during the investigation the diminution of the amount became of equal interest. I have found no analyses undertaken for the solution of these questions, some of Sir C. SCUDAMORE's alone being excepted; and these are so made that it is impossible to compare them with those which will here be given.

Though Dr. PROUT long since remarked that excess of phosphates accompanied some affections of nervous structures, yet no analytical results were stated, and the observation seems to have referred to the earthy phosphates alone.

I have in vain as yet sought for some immediate method for approximately determining the total amount of phosphatic salts in the urine. An analysis, requiring five or six hours to perform, is at present the only satisfactory process which can be recommended. Most of the following experiments were made on the water first passed in the morning, and before food: occasionally this could not be obtained, and then the night or afternoon water was taken. Almost all the cases were in St. George's Hospital, and therefore under nearly the same circumstances, as far as exercise was concerned. The diet usually varied with the state of the patient. The details of the cases would extend beyond the limits of the present paper.

Had it been possible, I should have much preferred to make my experiments on the total quantity of urine passed during the twenty-four hours, by which means, measuring the quantity, the total amount of phosphates thrown out of the body would have been known; but I found it utterly impossible to obtain any approach to accuracy in regard to the quantity of water passed in the twenty-four hours. The results would have been so valuable, that it was only when I found by experience how uncertain and inaccurate they must be, that I gave up the plan I had formed. Instead of giving the quantity of phosphatic salts in 1000 parts of urine, of certain specific gravity, it may be thought that a comparative view would have been better taken by calculating the solid residue in each case, from some of the various tables which give the amount

of solid residue in 1000 parts of urine of all specific gravities. But no tables admit of this calculation. They may perhaps be true for the total quantity of water in twenty-four hours; but they are not so for the water made at any one period of the day. The water made before and after dinner, for instance, may have the same specific gravity, but the total quantity of solid residue in each may be entirely different. If the urine was a solution of any single substance such tables would be useful, but where there are many substances present in varying quantities at different periods, these formulæ are inapplicable.

In my previous paper I have shown, that in the healthy state the amount of earthy phosphates precipitable by ammonia depends chiefly on the amount of earthy matter taken into the body; the amount varying from ·40 per 1000 urine, specific gravity 1027·9, to 1·49 per 1000 urine, specific gravity 1030.

I have also shown that the alkaline phosphates vary from 7·56 per 1000 urine, specific gravity 1027·9, to 5·77 per 1000 urine, specific gravity 1030.

In the following paper I shall attempt to show that the earthy phosphates are subject to such great variations, depending on the water, the food, and the medicine even, that from their estimation alone no result can be arrived at. I shall then give the total amount of earthy and alkaline phosphates in diseases, in which the nervous tissues, or their neighbouring tissues, are affected.

1. In diseases of the spine; from accidents, caries, paraplegia.
2. In diseases of the membranes and chronic diseases of the brain.
3. In fractures of the bones of the skull.
4. In acute diseases of the brain.
5. In functional diseases of the brain; as violent delirium and delirium tremens.
6. In insane patients.

I shall lastly, for comparison, give the amount of earthy and alkaline phosphates in some diseases in which the nervous tissues may be considered as unaffected.

1. In acute diseases; as acute rheumatism, gout, fever.
2. In chronic diseases, as Bright's disease; diseases in which very small quantities of water are secreted; scrofulous diseases, exostosis and mollities ossium.

TABLE I.—On the Variations of the Earthy Phosphates.

	Earthy phosphates.	Specific gravity.
Case 1. Water passed about 12 o'clock during ten successive days, in a severe case of concussion of the brain from a fall.		
3rd day. No food	·97 per 1000 urine.	1013·2
4th day. No food	·36	1014·5
5th day. No food	·74	1011·4
6th day. No food	1·07	1019·3
7th day. No food	1·28	1019·1
8th day. Some food	·85	1017·5
9th day. More food	1·10	1018·3
10th day. More food	1·05	1020·1
11th day. More food	·52	1010·8
12th day. More food	1·96	1021·9
Case 2. Water passed in the afternoon by a patient with pain in the head and epileptic fits (chronic).		
About 40th day. After salts and senna	2·93	1026·2
51st day	1·55	1015·6
73rd day	1·47	1025·7
90th day	1·35	1023·7
Case 3. Severe pain in the head (chronic).		
About 60th day, afternoon	2·03	1018·5
63rd day	·53	1010·1
Case 4. Inflammation of the brain (acute).		
20th, afternoon	1·15	1031·8
26th day. Died.		
Case 5. Tetanus. Afternoon	1·35	1026·5
Case 6. Delirium tremens	1·21	1030·4

Hence from Case 1, the variations in the earthy phosphates during ten successive days appear to follow no rule. Case 2 has been mentioned in the previous paper as showing the effect of sulphate of magnesia. From the other cases the amount of earthy phosphates seemed to be about the healthy standard. The general conclusion is, that the variations in the earthy phosphates are independent of the nature of the disease; and this conclusion will be found to be confirmed by the subsequent experiments.

TABLE II.—On the Total Amount of Earthy and Alkaline Phosphates in those Diseases in which the Nervous Tissues, or their neighbouring tissues, are affected. And first of Disease of the Spine, from accidents, caries, paraplegia, &c.

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 1. Fractured spine, seventh cervical vertebra.				
2nd day	·12 per 1000 urine.	1023·1	3·71	3·83
3rd day	·41	1017·6	2·29	2·70
8th day	·67	1022·0	7·76	8·43
9th day	·67	1023·1	7·47	8·14
16th day	·41	1011·4	3·43	3·84
18th day	·53	1010·6	3·13	3·66
21st day. Died.				

TABLE II. (Continued.)

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 2. Fractured spine, eleventh dorsal vertebra.				
2nd day	·86 per 1000 urine.	1029·2	8·35	9·21
4th day	·94	1025·9	8·00	8·94
5th day	·75	1025·0	8·04	8·79
7th day	·56	1022·8	5·17	5·73
12th day	·15	1007·8	1·29	1·44
36th day. Died.				
Case 3. Recent paraplegia.				
14th day. Water passed from evening to morning	2·15	1026·5	5·88	8·03
19th day	·70	1016·6	1·34	2·04
22nd day	1·09	1017·9	2·00	3·09
27th day	1·00	1021·3	2·56	3·56
34th day	1·13	1019·4	3·14	4·27
59th day	1·45	1019·9	2·39	3·84
109th day	1·31	1021·2	2·86	3·17
Case 4. Recent paraplegia. Head long slightly affected.				
19th day, afternoon water	2·00	1023·2	1·78	3·78
24th day, morning water	·53	1012·6	3·34	3·87
Case 5. Paralysis from arsenic almost complete.				
20th day	.....	1008·6	.....	1·69
21st day	·60	1014·8	3·96	4·56
Case 6. Chronic paraplegia (three months)	1·13	1019·4	3·56	4·69
Case 7. Chronic paraplegia (five months)	·49	1015·9	1·51	2·00
Case 8. Paraplegia (seven or eight years' curvature) twelve months	·30	1007·5	·84	1·14
Case 9. Paraplegia. Tabes?	·44	1012·2	·35	·79

In Case 1, on the eighth and ninth day, a slight excess is observable. This is also present in Case 2 on the second, fourth and fifth day; and in chronic cases the quantity of phosphatic salts is, if anything, lower than natural.

TABLE III.—On the Total Amount of Earthy and Alkaline Phosphates in Diseases of the Membranes, and in some Chronic Diseases of the Brain.

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 1. Scalp wound, doing well. On the 16th day from accident, acute inflammation of the membranes began.				
3rd day of inflammation	·56 per 1000 urine.	1022·4	3·94	4·50
4th day	·58	1020·1	5·07	5·65
5th day. Died.				
Case 2. Scalp wound. On the 18th day acute inflammation of membranes began.				
5th day of inflammation	·15	1025·3	6·17	6·32
7th day. Died.				
Case 3. Scalp wound. On the 16th day diffuse inflammation of membranes began.				
9th day of inflammation	·10	1011·5	2·70	2·80
11th day	·09	1008·0	1·96	2·05
Case 4. Two years' chronic disease of the bones and membranes	1·25	1017·4	2·60	3·85
Case 5. Pain in the head, ending in total blindness at last.				
30th day	·27	1021·3	·69	·96
35th day	·33	1010·1	·27	·60
54th day	·74	1015·2	2·33	3·07
71st day	·56	1006·0	·32	·88
82nd day	·13	1010·0	1·30	1·43
89th day	·93	1011·2	2·42	3·35
359th day. Died of softening of the brain.				

TABLE III. (Continued.)

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 6. 4th day. Slight paralysis of fifth nerve	·76	1012·6	·46	1·22
Case 7. 4th day. Recent hemiplegia	·75	1010·2	1·14	1·89
14th day. Recovered.				
Case 8. 3rd day. Recent hemiplegia	1·84	1027·0	4·50	6·34
Case 9. Diabetes, effusion in brain. Sugar in effused fluid	1·70	1033·9	1·58	3·28

In the acute inflammation of Case 1 and 2 no increase of phosphates is observed. The marked chronic attack in Case 5 shows, if anything, a deficiency. Slight cases of paralysis show no increase.

TABLE IV.—On the Total Amount of Earthy and Alkaline Phosphates in cases of Fractures of the Bones of the Skull.

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 1. Fracture of the base of the skull.				
3rd day	2·09 per 1000 urine	1030·0	7·20	9·29
5th day	1·74	1021·3	2·60	4·34
8th day	1·66	1019·6	5·00	6·66
14th day	·60	1020·0	1·51	2·11
18th day. Rigor, pain in the head	1·34	1021·2	8·63	9·97
21st day. Acute pain in side	·61	1019·1	2·69	3·30
23rd day. Excessive pleurisy	·75	1016·9	3·19	3·94
26th day	·15	1022·2	1·05	1·20
31st day.....	·73	1024·8	6·26	6·99
50th day. Acute pericarditis	·73	1027·3	3·74	4·47
118th day. Recovered	·38	1018·3	3·31	3·69
Case 2. Fracture of the base of the skull.				
4th day.....	·13	1026·3	9·40	9·53
5th day.....	·27	1026·5	10·43	10·70
6th day. 32 ʒ passed	·30	1022·8	7·61	7·91
7th day.....	·15	1024·7	4·67	4·82
9th day. Erysipelas	·12	1017·6	4·12	4·24
15th day.....	·57	1018·5	3·43	4·00
32nd day. Went out well.				
Case 3. Fracture of frontal bone.				
2nd day	·36	1026·4	4·81	5·17
7th day	·72	1019·3	3·12	3·84
Case 4. Fracture of the base of the skull.				
2nd day	·52	1028·6	3·50	4·02
4th day	1·24	1029·8	5·89	7·13
7th day	·71	1017·5	4·11	4·82

In Case 1, on the 3rd and 18th day, when the head symptoms were most marked, the phosphates were above the average. In the same case, when other acute inflammations supervened, as on the 23rd and 50th day, no increase was observed. In Case 2 also, on the 4th, 5th and 6th days, when the head symptoms were urgent, the total amount of phosphates was considerably above the average; on the 9th day, when erysipelas came on, no increase was seen. In this case the earthy phosphates are worthy of note. Cases 3 and 4 were severe fractures, but without acute symptoms.

TABLE V.—On the Total Amount of Earthy and Alkaline Phosphates in acute Diseases of the Brain.

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 1. Acute inflammation of the brain.				
12th day	1·82 per 1000 urine.	1029·7	11·33	13·15
14th day	2·31	1033·0	9·80	12·11
16th day	1·35	1030·0	8·18	9·53
18th day. Died.				
Case 2. Acute inflammation.				
16th day	·90	1025·3	5·93 5·93	6·83
17th day	1·48	1028·1	8·31 8·43	9·79 9·91
19th day	1·02	1024·8	7·41	8·43
20th day. 58ʒ	·98	1021·2	4·79	5·77
21st, morning. 24ʒ	·62	1016·9	3·63	4·25
21st, night. 14ʒ	1·10	1024·6	5·98	7·08
22nd day. Died.				
Case 3. Acute disease; apoplexy, paralysis.				
22nd day	1·52	1021·6	6·52	8·04
23rd day	1·66	1023·1	4·43	6·09
24th day	2·08	1032·7	7·48	9·56
27th day	1·48	1026·9	4·56	6·04
28th day	1·35	1025·4	4·07	5·42
33rd day. 26ʒ water	·68	1018·6	1·47	2·15
34th day. 18ʒ water	1·05	1024·3	4·94	5·99
96th day. Went out in a state of dementia.				
Case 4. Acute inflammation supervening on chronic disease.				
21st day of severe symptoms	1·89	1031·1	11·49	13·38
23rd day	1·67	1022·9	4·36	6·03
30th day	1·44	1016·3	1·35	2·79
Went out relieved.				
Case 5. Acute hydrocephalus. Three years old.	Died.	.....	.....	6·41

In Case 1 the symptoms were most strongly marked. In Case 2 there was a doubt whether the symptoms were to be attributed to typhoid fever or to affection of the brain. The progress of the case and the examination showed the inflammation of the nervous tissues. Case 3 was more chronic, but with acute symptoms occasionally. Case 4 yielded to very active treatment.

TABLE VI.—On the Total Amount of the Earthy and Alkaline Phosphates in some functional Diseases of the Brain.

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 1. Violent delirium, with erysipelas on the third day after scalp wound.				
4th day of erysipelas	·30 per 1000 urine.	1026·2	8·69	8·99
Case 2. Violent delirium. Mania? Abscess of the neck.				
10th day	·90	1025·9	8·16	9·06
13th day	·90	1025·4	5·72	6·62
16th day	·30	1010·8	1·22	1·52
Case 3. Last day of phthisis. Raving. Urine very scanty	·63	1025·6	7·91	8·54

TABLE VI. (Continued.)

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 4. Intense delirium. Epileptic fits continually.				
2nd day	2·21 per 1000 urine.	1022·6	7·75	9·96
3rd, morning	2·56	1024·8	12·19	14·75
3rd, night	2·15	1023·7	12·23	14·38
4th, night	2·71	1022·8	9·39	12·10
5th, night	1·53	1019·4	·34 / ·28	1·87 / 1·81
6th, night	·74	1020·5	5·16	5·90
9th, night	.....	1021·4	.....	3·93
12th, night	·15	1020·2	2·93	3·08
25th, night. Died.				
Case 5. Seven days' continued fever; excessive delirium	·24	1017·8	5·43	5·67
Case 6. Continued fever, muttering delirium.				
14th day	·41	1026·0	4·37	4·78
16th day	·37	1022·0	1·89	2·26
19th day	·10	1009·2	2·53	2·63
Case 7. 6th day. Delirium tremens. Urine very scanty. Recovered.		1028·7	.....	1·07
Case 8. 4th day. Delirium tremens. 4ʒ water.	·19	1019·1	2·21	2·40
5th day. 7ʒ water	·04	1019·3	·11 / ·08	·15 / ·12
6th, morning. 6ʒ water	.....	1017·9	.....	·06
6th, evening. 6ʒ water	.....	1019·7	.....	·24
6th, night. Died.				
Case 9. 5th day. Delirium tremens	·10 / ·09	1018·0	0·00	·10 / ·09
6th day. Taking food	·79	1022·5	5·31	6·10
8th day	.....	1027·9	.....	8·41
9th day. Well	·90	1022·9	6·07	6·97
25th day. Remained in for injury	·42	1010·9	1·01	1·43
Case 10. 4th day. Delirium tremens	·45	1024·0	3·13	3·58
7th day. Recovering	·72	1025·3	5·81	6·53
Case 11. 5th day. Delirium tremens, slight	·89	1021·6	5·45	6·34
6th day. Recovering	·77	1019·1	3·41	4·18
Case 12. 2nd day. Delirium tremens, slight	·56	1019·6	4·13	4·69
Case 13. 6th day. Delirium tremens	.....	1011·0	.....	2·07

In this Table are placed those cases which from their symptoms or post-mortem appearances could not be affirmed to be inflammations of the brain. Case 4 was most remarkable: the violent symptoms abated on the 5th day; but the post-mortem examination on the 26th day showed no positive marks of inflammatory action. On this account I have placed it in the class of functional diseases: further experiments may ultimately show, that the great increase in alkaline phosphates alone is sufficient to indicate the nature of the disease. In Cases 5 and 6 no excess of phosphates is observable. The 5th and 6th days of Case 8 are particularly remarkable. The 6ʒ of water on the 6th morning were strongly acid to test-paper, and remained so for eight days in June. Case 9; the 5th day was most remarkable, as no alkaline phosphate was present: the urine was acid to test-paper. In the other cases of delirium tremens, when food could be taken, the phosphates did not appear to be much affected.

TABLE VII.—On the Total Amount of Earthy and Alkaline Phosphates in Insane Patients.

For the opportunity of seeing and examining these cases I am indebted to Dr. ALEXANDER SUTHERLAND, who allowed me to choose among his patients in St. Luke's Hospital those cases which I thought to be most suitable.

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 1. General paralysis. Early case	1·50 per 1000 urine.	1028·6	5·40	6·90
Same case	1·17	1023·3	2·97	4·14
Case 2. General paralysis. Early case	·79	1022·0	1·23	2·02
Case 3. General paralysis. Early case	·41	1016·6	5·36	5·77
Case 4. General paralysis. Early case	.....	1018·3	.....	1·30
Case 5. Extreme case. Paraplegia. Many years.	.....	1006·7	.....	1·35
Case 6. Mania	·42	1023·3	4·38	4·70
Case 7. Mania; acute paroxysm	1·32	1029·3	7·58	8·90
Same patient convalescent	·67	1020·0	2·44	3·11
Case 8. Mania. Some months	.....	1025·9	.....	1·26
Case 9. Mania. Four months	·74	1015·3	·38	1·12
Four months and a half	·72	1015·9	·46	1·18
Case 10. Melancholia	·67	1024·3	3·36	4·03
Case 11. Melancholia	.....	1011·3	.....	2·71
Case 12. Melancholia	·71	1025·9	3·08	3·79
Case 13. Melancholia. Recent	1·47	1027·9	2·34	3·81
Case 14. Senile dementia	·71	1021·0	2·10	2·81

In the five cases of general paralysis no increase of the total amount of phosphates is observed. Case 7, during an acute paroxysm of mania, shows a slight increase in the total amount of phosphates. Case 8 and 9, also of mania, appear more to approximate to the state of urine in delirium tremens. The cases of melancholia present nothing remarkable.

TABLE VIII.—On the Total Amount of Earthy and Alkaline Phosphates in Diseases, in which the Nervous Tissues, or their neighbouring tissues, are not affected.

1. In some acute diseases.

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 1. 5th day. Inflammation from crushed arm	·60 per 1000 urine.	1024·8	5·57	6·17
Case 2. 6th day. Acute rheumatism; 2nd day, pericarditis	·73	1026·6	5·79	6·52
Case 3. 4th day. Acute rheumatism	·78	1023·7	4·07	4·85
Case 4. 8th day. Acute rheumatism	1·28	1023·9	3·63	4·91
Case 5. 11th day. Acute rheumatism; 1st day, pericarditis	·45	1010·2	1·65	2·10
Case 6. Acute rheumatism	·09	1016·7	2·91	3·00
Case 7. Acute gout	·60	1015·1	2·50	3·10
Case 8. Acute gout	.....	.....	.....	3·06
Case 9. 2nd day, of erysipelas; slight	·33	1016·6	2·48	2·81
Case 10. 4th day, of scarlet fever	·33	1010·4	1·19	1·52
Case 11. 2nd week, of petechial fever	·38	1011·8	1·84	2·22

These cases of acute inflammation and fevers show no increase in the total amount of phosphatic salts.

TABLE IX.—On the Total Amount of Earthy and Alkaline Phosphates in Diseases, in which the Nervous Tissues, or their neighbouring Tissues, are not affected.

2. In some chronic diseases.

	Earthy phosphates.	Specific gravity.	Alkaline phosphates.	Total.
Case 1. Probable congestion of the kidneys only	·85 per 1000 urine.	1026·4	4·68	5·53
Case 2. Bright's disease, six months. Acute inflammation of abdomen	·34	1028·0	6·59	6·93
Case 3. Bright's disease, thirteen weeks	·15	1018·1	3·15	3·30
Case 4. Bright's disease, two months and a half. Acute pericarditis; 2nd day	·12	1012·6	1·31	1·43
Case 5. Bright's disease; four months. Recovering	·15	1008·5	1·68	1·83
Case 6. Bright's disease; three weeks	·75	1018·6	2·94	3·69
Case 7. Bright's disease without dropsy. Paraplegia, 2nd day	·39	1006·1	·37	·76
12th day	·15	1007·7	1·07	1·22
23rd day. Comatose	·08	1010·0	·89	·97
Case 8. Ascites-jaundice; eleven weeks. Very scanty urine	1·05	1025·6	8·43	9·48
Case 9. General dropsy, 21st day. Urine very scanty	·67	1019·2	7·11	7·78
23rd day	·99	1019·9	4·67	5·66
Case 10. Phthisis; seven months. Urine very scanty	·45	1017·6	5·64	6·09
Case 11. Phthisis languid; three months	·21	1013·9	1·31	1·52
Case 12. Schirrus pylorus. Excessive wasting for eighteen months	·41	1012·3	3·61 3·55	4·02 3·96
Case 13. Diabetes mellitus	.....	1043·2	.....	2·66
Case 14. Scrofulous abscess	1·05	1021·8	3·54	4·59
Case 15. Scrofulous abscess; three years	.....	1027·7	.....	4·62
Case 16. Scrofulous abscess; four years	.....	1022·5	.....	5·07
Case 17. Scrofulous abscess: two years	.....	1020·4	.....	4·35
Case 18. Scrofulous abscess; one month	·30	1019·5	2·48	2·78
Case 19. Chorea, chronic	·15	1008·2	2·43	2·58
Case 20. Exostosis; severe	1·12	1026·5	4·65	5·77
Same case	·75	1020·0	4·81	5·56
Same case	·66	1018·9	5·58	6·24
Case 21. Mollities ossium; extremely acute case, November 2.	.....	1043·2	.....	5·68
November 17	1·20	1039·6		
December 27	1·43	1031·3	6·62	8·05
December 29	1·57	1037·9	6·67	8·24
December 30	1·72	1042·7	10·13	11·85
January 2. Died.				
Case 22. Mollities ossium; very chronic case...	·64	1020·2	3·74	4·38
A month afterwards	·46	1016·5	4·70	5·16

The first seven cases of diseased kidney showed no increase, even when acute inflammation was present. In Cases 8, 9 and 10, a very small quantity of urine was secreted, and there is a slight apparent increase in the amount of phosphates. The cases of scrofula were dispensary patients of Mr. TOYNBEE's, and no increase of phosphates is observable in them. The case of exostosis was a very extreme case, and the phosphates are in about the healthy proportion. The first case of mollities was a still more severe one: there is a decided increase in the earthy phosphates; and the alka-

line phosphates at the last were also in excess, though there was no symptom whatever of affection of the nervous structures.

The conclusions I have drawn may be thus enumerated:—

Table I.—The variations in the earthy phosphates in one case, during ten successive days, appear to follow no rule. In the other cases the amount of earthy phosphates seemed to be about the healthy standard.

The general conclusion was, that the variations in the earthy phosphates were independent of the nature of the disease; and this conclusion is borne out by all the other tables.

Table II.—In fractures of the spine and paraplegia, the total amount of phosphatic salts was slightly above the healthy standard at the early period, when inflammatory action might be present; when chronic, or free from inflammation, the total quantity of phosphatic salts was lower than natural.

Table III.—In chronic diseases of the brain, and in chronic, and even acute diseases of the membranes, there was no increase of phosphates.

Table IV.—In fractures of the bones of the skull, when any inflammation of the brain appeared, there was a slight increase in the total amount of phosphates. When there were no head symptoms no increase of phosphates was observed, even though other acute inflammations supervened.

Table V.—In acute inflammation of the brain there was an excessive amount of phosphates secreted: when the acute inflammation became chronic no excess was observable.

Table VI.—In some functional diseases of the brain an excessive amount of phosphates was secreted; this ceased with the delirium. In other functional cases, as in fevers, no excess was observed. Delirium tremens showed no excess or deficiency when food could be taken; but in the most violent cases, when no food was taken, the phosphates were diminished in a most remarkable degree. In one case in which, at this period, there was no alkaline phosphate, the urine was acid to test-paper. In another, in which the total quantity of phosphatic salts $=\cdot 06$ per 1000 urine, there was a strong acid reaction: the urine remained acid for eight days in June.

Table VII.—In the general paralysis of the insane no increase of phosphates was observed. One case of acute paroxysm of mania showed a small increase during the paroxysm. In two other cases of mania there appeared a diminution of phosphates approaching to that in delirium tremens.

Table VIII.—Acute inflammations and fevers showed no increase.

Table IX.—Bright's disease, even with acute inflammation, showed no increase. Where only a few ounces of urine were secreted, as in dropsy, there was a slight apparent increase. In scrofulous diseases no increase was observed, nor in a very extreme case of exostosis. In the acute case of mollities ossium there was a decided increase in the earthy phosphates, and the alkaline phosphates at last were also in excess, though there was no symptom whatever of affection of the nervous structures.

The general conclusions are:—

1. That acute affections of nervous substance, organic and functional, are the only diseases in which an excess of phosphatic salts appears in the urine. In acute inflammation of the brain, the amount of phosphates seems to be proportional to the intensity of the inflammation. In some states of violent delirium the amount of phosphates may also be proportional to the delirium.

2. That in a large class of functional diseases of the brain, of which delirium tremens presents the most marked examples, the amount of phosphates is most remarkably diminished.

3. That no chronic diseases whatever show any marked excess in the total quantity of phosphatic salts secreted, at least as far as this mode of analysis is conclusive. One case of mollities ossium formed the only exception to these rules.